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Using Simulations to Enhance Teaching and Learning:

Encouraging the Creative Process

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Technology integration has become popular in education and as teachers we are always looking for ways to effectively utilize technology tools in our classrooms. At its inception, technology in education meant bringing in computers for teachers to use and any available software that was available. How times have changed! As technology integration evolves in the classroom, we now have a wide variety of teaching tools available to help facilitate student learning. One such tool is simulations.

A computer simulation is a teaching tool used to provide students with a realistic experience. It can serve as a technique for enhancing learning and increase a student's interest and awareness in the topic being discussed. Simulations provide opportunities for learners to explore environments that mirror real-world situations or complex ideas. Simulations also provide innovative ways to use technology. New computer technologies allow for a variety of strategies to design learning environments that are realistic, authentic, engaging, and fun (Kirkley & Kirkley, 2005).

During the fall 2005 semester, I worked with graduate level students in a Leadership in Educational Technology course on simulations. As most are K-12 teachers, the focus was on creating a technology-related simulation that could be used in their classrooms. The software program used for this activity was Microworlds EX (http://www.microworlds.com/solutions/mwex.html). This program is designed for middle school students and is built on the LOGO programming language.

This article defines and describes what simulations are as well as the process my students (prospective teachers working toward certification and/or practicing teachers working on their Mas-

ter's degree) went through as they designed and developed their very first technology-related simulation using the LOGO programming language. Based on the results, some strategies for future teacher training and development are given.

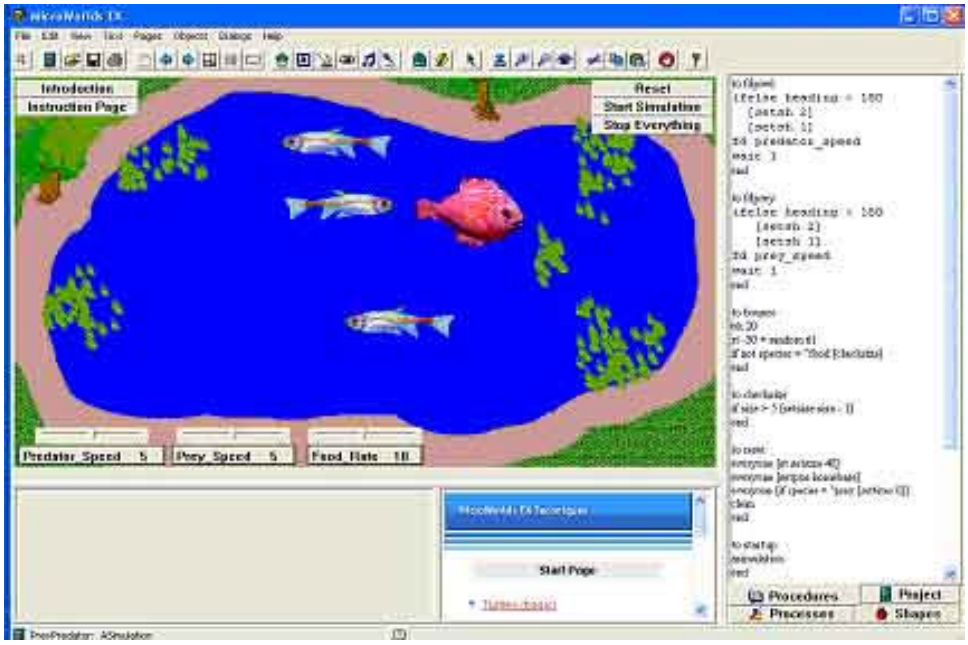

Figure 1. MicroWorlds Simulation Ecology of a Pond

How Simulations Work

Simulations provide students with an opportunity to practice problem based learning through a specific task, issue, crisis, or problem. An experience or real-life situation is imitated. When the situation or problem is presented, students work together to think of a possible solution and prove that it works or fits in with certain decision criteria. It is important to note that there is no one "right" answer or quick solution (Gredler, 1992).

Students are generally assigned roles and are expected to act within that role or setting regarding the subject matter and issues presented. Students carry out their roles in the simulation according to predetermined behavioral characteristics and descriptions regarding their topic. They become the character in the simulation and experience the "reality" of acting in the situation.

It is impossible to know with certainty the outcome of a simulation. It depends on how the learners experience their role and the extent to which they develop it. As such, students take ownership of their roles, have the responsibility for carrying out their assigned activities, and ultimately take responsibility for their own learning. During a simulation, the instructor functions more as a facilitator, helper, and resource person and less as an expert, judge, or tester (Hertel & Millis, 2002). This truly enhances the constructivist learning approach as students garner meaning from their interaction with the environment. Cognitive conflict or "puzzlement" then becomes the stimulus for learn-

ing and knowledge evolves through social negotiation and individual understanding (Kirkley & Kirkley, 2005).

How Simulations Enhance Learning

Simulations provide students with a very real experience and as such, they require a student's absolute involvement and participation. Students are interested and more aware of the topic and function as active participants (Hertel & Millis, 2002). This ultimately allows them to develop leadership skills and become more adept at analysis and problem solving activities. A constructivist learning environment is created whereby students weave together interdependent elements and information to solve real-world problems. The simulation thereby promotes a transfer of knowledge and helps with not only the education but also the application of a particular issue or concept. Ultimately students learn how to think critically in a complex situation (Brumfield, 2005).

Developing a Simulation

A simulation should be developed and planned based on the objectives of the learning activity. Once the objectives are known and established, the scope of the simulation can be defined. What question is going to be answered, what do the members plan to accomplish? Prepare students for the simulation by identifying critical concepts, skills, or content that is important for them to know before and during the simulation. The role of each of the participants must then be identified and assigned. Students need to have a good understanding of who they are during the simulation, what they will be doing, and what is expected of them. An overview of the situation should be provided as well as an introduction to the simulation. Once the exercise is completed, a debriefing is also necessary to fully assess and go through what happened during the simulation and ascertain student comments and reactions to the experience. Simulation issues, processes, and outcomes can then be linked to course concepts and learning objectives.

- General learning objectives commonly achieved through simulations include:
- Improved student awareness of a topic or subject
- Real-world and practical application of course concepts
- Enhanced analytical ability to resolve issues and problems in the subject matter
- Increased exposure to complex real-life experiences

Criteria should be established for grading attendance and participation as well as deliverables such as reports. Rules also need to be established for how students will interact with each other, how they will interact with the teacher, and whether outside resources or research is allowed during the simulation (Hertel & Millis, 2002).

Simulations Utilizing Technology

Simulations are one way to incorporate an innovative use of technology into the learning environment. Technology is not needed for the creation or administration of a simulation but technology can enhance the overall presence and impact of the simulation for students.

Using Simulations for Teaching & Learning

CD-ROMs, web-based tools, and/or desktop computer game simulations are being used to support learning through real-world problems, cases, and scenarios. Technology capabilities provide opportunities for designing innovative learning environments that allow for more interactive, relevant, and effective application of the material. Technology also makes it easier to provide a compilation of resources, tools, and experiences using real-world problems and techniques to participate, interact, and manipulate scenarios (Kirkley & Kirkley, 2005).

My Experience using Simulations

The twenty-five students in the Leadership in Instructional Technology course set out to design and develop a simulation using technology that could be utilized in their classroom. Students were divided into groups, such as by student grade level or subject content area. After the groups were set up, exploration and learning of the Microworlds EX software program began.

None of the students in the class had ever worked with a computer programming language and everyone had to learn the LOGO language before we could proceed with the activity. I introduced the interface as a group. We worked through some basic commands and then we worked on the first tutorial in the software package. There were a few glitches and some students became anxious due largely to the software's requirement for accuracy and the need to be detail oriented. After working on the first tutorial as a class, a discussion was held regarding what had been learned and what questions remained in order to be able to complete the main task – creating a simulation.

Next, each group worked independently on the second tutorial provided by the software package. After each group worked on the tutorial, the class again discussed what had been learned and what the concerns were. The students then worked on the third tutorial on their own. This process repeated itself until all tutorials were completed and everyone felt prepared to create their own unique simulation.

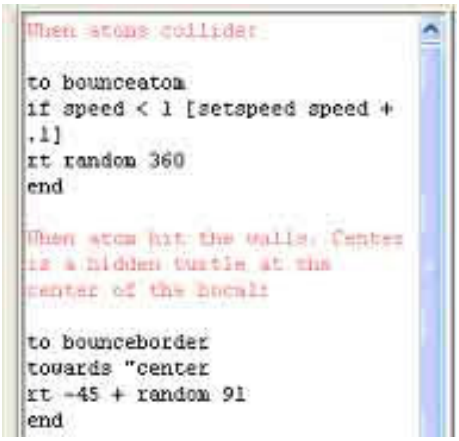

Figure 2. Typical MicroWorlds Code

Outcome

The most interesting element within the entire simulation study and development process was the reaction of the students themselves. It was a difficult task to think about creating a simulation from start to finish. This activity, rather than follow a linear step-by-step approach, required students to be creative and innovative as well as anticipate problems and solutions. Instead of just implementing something that had already been developed, the students were responsible for the actual development.

This was a radically different approach to learning than most of the students were used to. By the end of this activity, students were able to develop a workable simulation. Many of the teachers then took their experiences back to their own classrooms and had their students complete this exercise. We brainstormed ways students could use the Microworlds software to create a simple simula

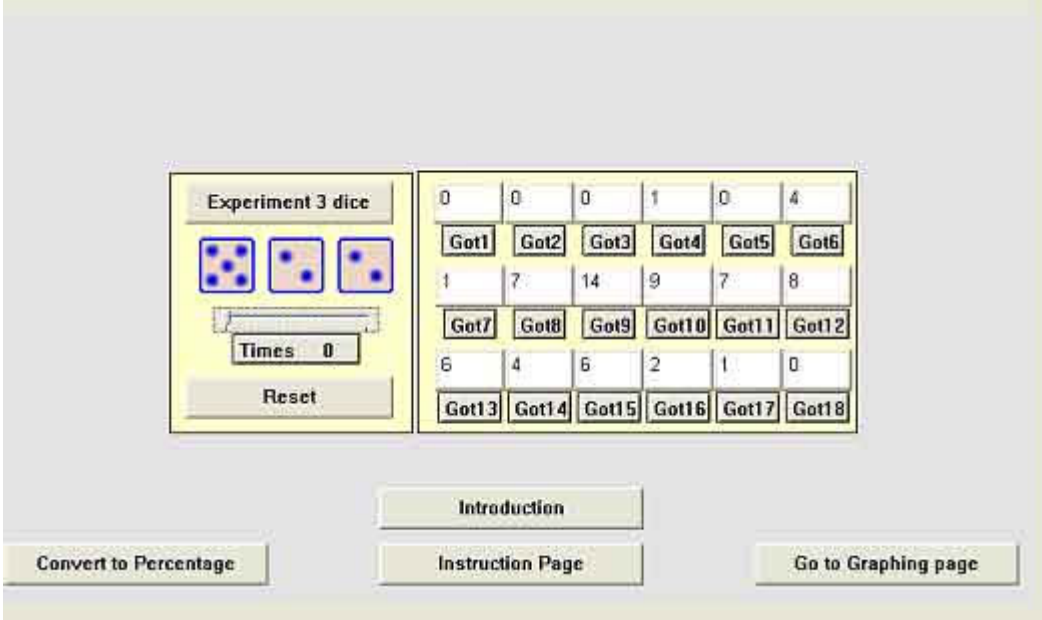

Figure 3. Roll the Die Simulation

tion and ways other technology-related simulations could be utilized. The feedback received from the students was that this was a good exercise for them to take back to their own classrooms for their students.

Conclusion

By using simulations to complement and enhance traditional teaching and learning, students are given an opportunity to participate in active learning. They are called upon to make decisions and through this team-based exercise they gain a better understanding of group dynamics and processes. Ultimately, simulations allow for a deeper exploration of a complex issue or concept with greater student involvement and enjoyment in the learning experience. Based on my experiences with my students, I would strongly encourage teachers to experiment with simulations in their classrooms for authentic, collaborative, and constructivist learning. As my students' experiences showed, developing simulations can be a challenging process, but in the classroom teachers can use their creativity and innovation to come up with interesting and fun simulation activities for their students.

In response to the challenges experienced by my students in developing technology-related simulations, I would advocate two strategies and solutions. First, keep it simple. In an article by Nightingale (2006), she advocates simplicity rather than elaborate concepts or complex technology. Second, continue to encourage technology-related professional development so teachers feel comfortable with the technology tools. When comparing technology usage to the amount of technology-related training, the more training teachers received, the more they viewed technology as an effective classroom tool for analyzing information, addressing critical thinking skills, and learning new concepts ("Teachers Talk Tech", 2006). Experiences such as those the students had in my class-

room with simulations can help better prepare them when working with this technology tool in their own classrooms.

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